

# **Apprenticeship and Industry Training**

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## **Ironworker – Reinforcing Ironworker Apprenticeship Course Outline 40-3-06 (2006)**

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**IRONWORKER**  
**Reinforcing Ironworker**

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## **Apprenticeship and Industry Training System**

Apprenticeship is post-secondary education with a difference. It helps ensure Alberta has a steady supply of highly-skilled employees, the foundation of our economy's future health and competitiveness.

Apprentices in more than 50 trades and crafts spend between one and four years learning their trade - 80% of the time on the job under the supervision of a certified journeyman or qualified tradesperson. The balance of the program is technical training in the theory, skills and technologies of their trade.

To become certified journeymen apprentices must learn theory and skills, and they must pass examinations. Requirements for certification - including the content and delivery of technical training - are developed and updated by the Alberta Apprenticeship and Industry Training Board (the Board) and a network of local and provincial industry committees.

The graduate of the Ironworker - Reinforcing Ironworker apprenticeship training is a journeyman who will be able to:

- responsibly do all work tasks expected of a journeyman.
- supervise, train and coach apprentices.
- demonstrate the principles of drafting, how drawings originate and how to correctly interpret the information given. The use of each type and the related work orders, materials, lists, etc.
- comply with all applicable Codes and Regulations with reference to materials, its uses and safety.
- identify structural shapes, ropes, wire and fibre as it relates to structural and ornamental components.
- demonstrate the placement of pre-cast concrete and concrete reinforcement materials to an acceptable level of workmanship.
- use hand tools and powered equipment in a proper and safe manner.
- perform a satisfactory operation with oxy-fuel or electric arc welding equipment in order to facilitate this work.
- co-ordinate iron work with other trades on the job site.

## **Apprenticeship and Industry Training Committee Structure**

While government supports Alberta's apprenticeship and industry training system, it is driven by industry, a term which includes both employers and employees. The Alberta Apprenticeship and Industry Training Board, with the support of Alberta Advanced Education, oversees the system. But the system relies on a network of industry committees. These committees include local and provincial apprenticeship committees (LACs and PACs) in the designated trades and occupational committees in the designated occupations, as well as other committees such as provisional committees established before the designation of a new trade or occupation comes into effect. All these committees are composed of equal numbers of employers and employees. The network of industry committees is the foundation of Alberta's apprenticeship and industry training system.

### **Local Apprenticeship Committees (LAC)**

Wherever there is activity in a trade, the Board can set up a LAC. The Board appoints equal numbers of employees and employers for terms of up to three years. The committee appoints a member as presiding officer. Local Apprenticeship Committees:

- monitor the apprenticeship system, and the progress of apprentices in their trade, at the local level.
- help settle certain kinds of issues between apprentices and their employers.
- recommend improvements in apprenticeship training and certification to their trade's provincial apprenticeship committee.
- make recommendations to the Board regarding the appointment of members to their trade's PAC.

### Provincial Apprenticeship Committees (PAC)

The Board establishes a PAC for each trade and, based on PAC recommendations, appoints a presiding officer and equal numbers of employees and employers for terms of up to three years. Most PACs have nine members. Provincial Apprenticeship Committees:

- identify the training needs and content for their trade.
- recommend to the Board the standards for training and certification for their trade.
- monitor the activities of local apprenticeship committees in their trade.
- make recommendations to the Board about the designation of trades and occupations.
- determine whether training of various kinds is equivalent to training provided in an apprenticeship program in the trade.
- may participate in resolving any apprenticeship-related disputes between employers and employees.

#### Ironworker PAC Members

Mr. A. O'Neill	Calgary	Presiding Officer
Mr. R. Calver	Calgary	Employer
Mr. W. McKee	Calgary	Employer
Mr. D. Heinrichs	Edmonton	Employer
Mr. J. Norris	Edmonton	Employer
Mr. M. Bergeron	Calgary	Employee
Mr. W. Bienz	Calgary	Employee
Mr. S. Hildebrand	Edmonton	Employee
Mr. D. Laboucan	Edmonton	Employee

### The Alberta Apprenticeship and Industry Training Board (Board)

The mandate of the Alberta Apprenticeship and Industry Training Board relates to the standards and requirements for training and certification in programs under the *Apprenticeship and Industry Training Act*. The Board provides advice to the Minister of Advanced Education on the training and certification of people in designated trades and occupations and on the needs of the Alberta labour market for skilled and trained persons. The Board also makes orders and regulations respecting standards and requirements for apprenticeship programs and the training of apprentices and for training and certification in designated trades and occupations, and the criteria or requirements for granting and recognizing trade and other certificates.

The 13-member Board consists of a chairman, eight members representing trades and four members representing other industries. The trades and other industry members are equally represented by employer and employee representatives.

### Safety Education

Safe working procedures and conditions, accident prevention and the preservation of health are of primary importance in apprenticeship programs in Alberta. These responsibilities are shared and require the joint efforts of government, employers, employees and the public. Therefore, it is imperative that all parties become aware of circumstances that may lead to injury or harm. Safe learning experiences and environments can be created by controlling the variables and behaviours that may contribute to or cause an accident or injury.

It is generally recognized that a safe attitude contributes to an accident free environment. Everyone will benefit as a result of a healthy, safe attitude towards prevention of accidents.

A tradesperson is possibly exposed to more hazards than any other person in the work force and, therefore, should be familiar with and apply the Occupational Health and Safety Act and Regulations dealing with personal safety and the special safety rules applying to each task.

### **Legal and Administrative Aspects of Safety**

Accident prevention and the provisions of safe working conditions are the responsibilities of an employer and employee.

#### **Employer's Responsibilities**

The employer is responsible for:

- providing and maintaining safety equipment, and protective devices and clothing.
- enforcing safe working procedures.
- providing safeguards for machinery, equipment and tools.
- observing all accident prevention regulations.
- training employees in the safe use and operation of equipment.

#### **Employee's Responsibilities**

The employee is responsible for:

- working in accordance with the safety regulations pertaining to the job environment.
- working in such a way as not to endanger themselves or fellow employees.

#### **Occupational Health and Safety's Responsibilities:**

Occupational Health and Safety (Alberta Human Resources and Employment) will conduct periodic inspections of the workplace to ensure that safety regulations for industry are being observed.

### **Technical Training Establishment**

Alberta Advanced Education, Apprenticeship and Industry Training offer your apprenticeship training program. Staff and facilities for delivering the program are supplied by Northern Alberta Institute of Technology.

**Procedures for Recommending  
Revisions to the Course Outline**

Apprenticeship and Industry Training, Industry Programs and Standards has prepared this course outline in partnership with the Ironworker - Reinforcing Provincial Apprenticeship Committee.

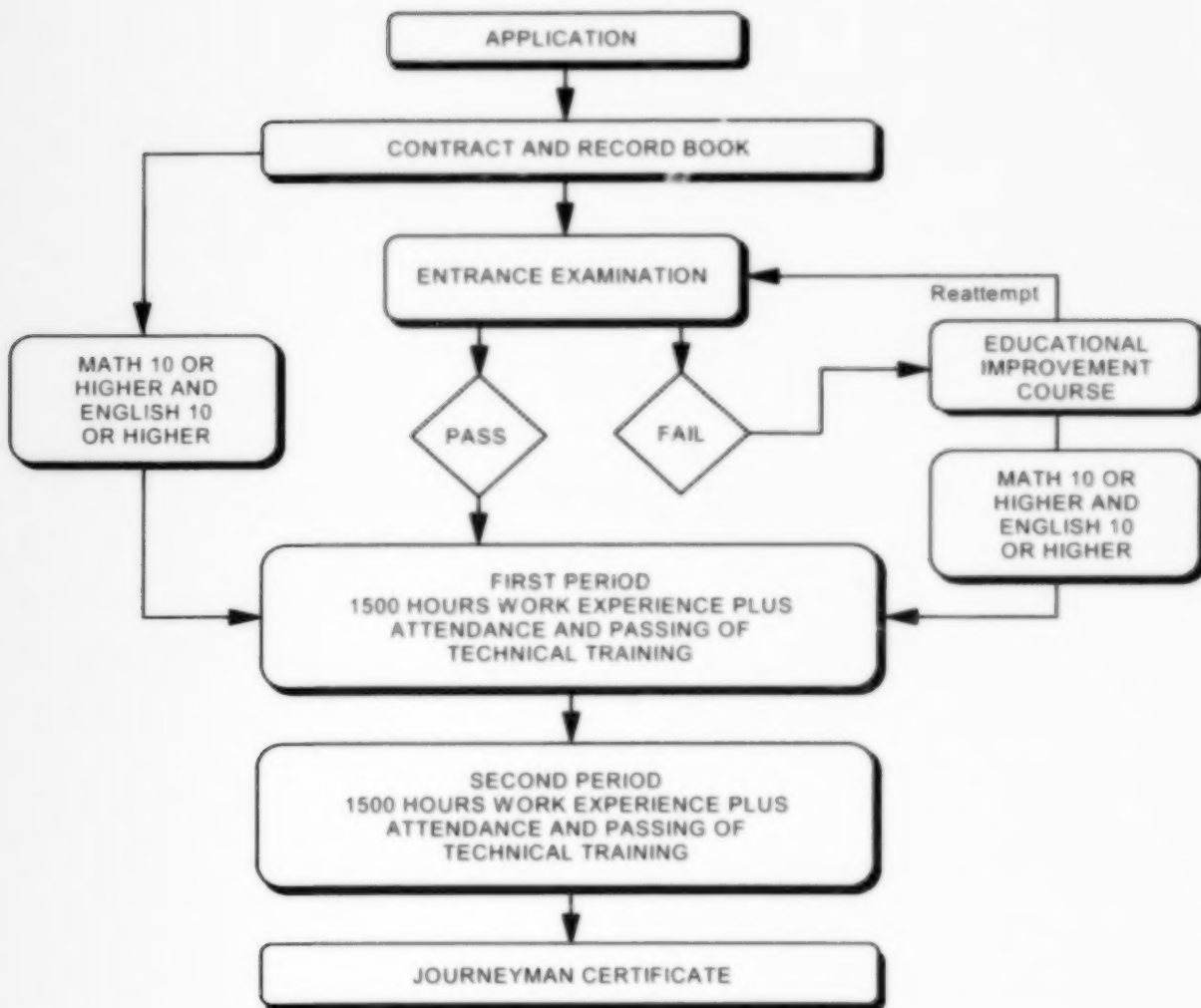
This course outline was approved March 7, 2006 under the authority of the Alberta Apprenticeship and Industry Training Board on a recommendation from the Provincial Apprenticeship Committee. Valuable input is acknowledged from industry and the institutions.

Any concerned citizen or group in the Province of Alberta may make recommendations for change by writing to:

Ironworker Provincial Apprenticeship Committee  
c/o Industry Programs and Standards  
Apprenticeship and Industry Training  
10th floor, Commerce Place  
10155 - 102 Street  
Edmonton, AB T5J 4L5

It is requested that recommendations for change refer to specific areas and state references used. Recommendations received will be placed before regular meetings of the Provincial Apprenticeship Committee.

# Apprenticeship Route toward Certification



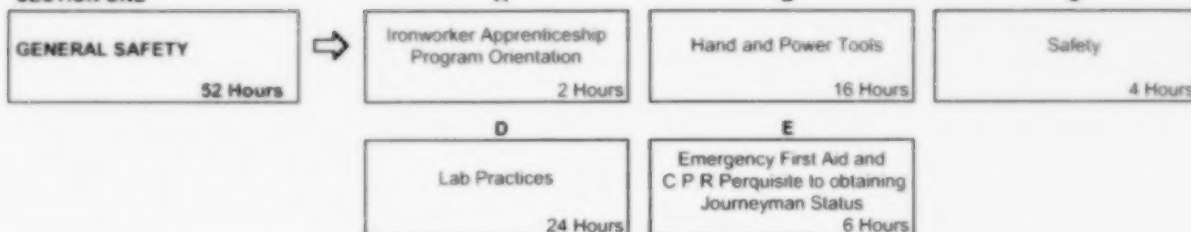


# IRONWORKER- REINFORCING IRONWORKER TRAINING PROFILE

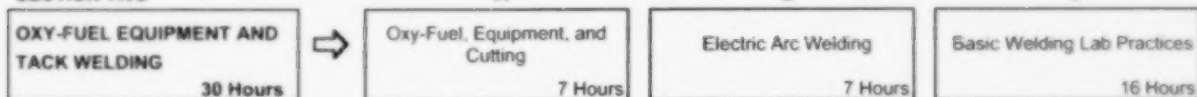
## First Period

(6 weeks 30 hours per week – total 180 Hours)

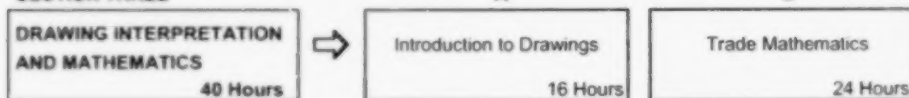
### SECTION ONE



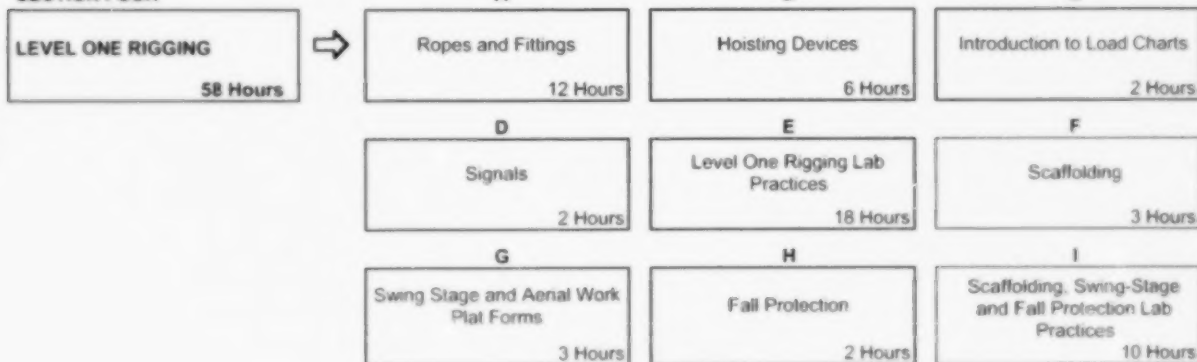
### SECTION TWO



### SECTION THREE



### SECTION FOUR



**Second Period**  
(6 weeks 30 hours per week - total 180 Hours)

**SECTION ONE**

**DRAWING INTERPRETATION  
AND MATHEMATICS**  
60 Hours



**A**

Reinforcing Steel Drawings  
24 Hours

**B**

Post-Tensioning Drawings  
12 Hours

**C**

Mathematics & Estimating  
24 Hours

**SECTION TWO**

**REINFORCED CONCRETE**  
102 Hours



**A**

Concrete  
6 Hours

**B**

Reinforcing Steel  
32 Hours

**C**

Reinforcing Steel Lab  
Practices  
36 Hours

**D**

Cranes  
12 Hours

**E**

Post-Tensioning  
10 Hours

**F**

Post-Tensioning Lab  
Practices  
6 Hours

**SECTION THREE**

**TRADE RELATED  
KNOWLEDGE**  
13 Hours



**A**

Business Knowledge  
10 Hours

**B**

Materials Knowledge  
6 Hours

**C**

Quality Control  
2 Hours

**FIRST PERIOD TECHNICAL TRAINING  
IRONWORKER TRADE  
COURSE OUTLINE**

**SECTION ONE: ..... GENERAL SAFETY ..... 52 HOURS**

**A. Ironworker Apprenticeship Training Program Orientation ..... 2 Hours**

**Outcome:** *Describe the responsibilities and opportunities in the Ironworker Trade.*

1. Describe the apprenticeship training system in Alberta.
2. Identify the training profile of Ironworker Apprenticeship in Alberta.
3. Explain the Ironworker program outline learning outcomes and objectives.
4. Describe the responsibilities for the Contract of Apprenticeship by the apprentice, employer and Alberta Apprenticeship and Industry Training.
5. Identify industrial, commercial and construction fields that provide employment opportunities for ironworkers.
6. Discuss the contents of the apprenticeship training record book.
7. Demonstrate the ability to complete an acceptable resume.

**B. Hand and Power Tools..... 16 Hours**

**Outcome:** *Use hand and power tools.*

1. Describe and demonstrate the safe use of hand and power tools used in the trade:
  - a) measurement, layout and alignment tools
  - b) squaring and marking tools
  - c) heating, cutting and bending tools
  - d) punching, boring and drilling tools
  - e) securing and assembly tools
  - f) prying and dismantling tools
  - g) clamping tools
  - h) grinding tools
2. Describe the types and bonds of grinding stones.
3. Demonstrate safety procedures for dressing grind stones.
4. List and describe:
  - a) drill sizes
  - b) drill speeds and feeds
  - c) materials and cutting fluids uses of countersinking points
5. Describe the types of layout tools and their uses.
6. Describe the uses of:
  - a) tape measures
  - b) squares, scribes
  - c) centre punches
  - d) trammels
  - e) chalk lines
7. Describe and demonstrate the correct use of levelling instruments.
8. Describe and demonstrate the correct use of a transit level.
9. List the advantages of a transit level.
10. Define and describe a spirit level and laser levels.

**C. Safety ..... 4 Hours****Outcome      Use general safe work practices.**

1. Recognize and correct the common causes of accidents in the work environment:
  - a) inattention to work
  - b) alcohol and drugs
  - c) prescription drugs
  - d) ineffective guarding
  - e) inadequate housekeeping
  - f) attitude
  - g) improper use of tools
  - h) unsuitable clothing
  - i) excessive haste
  - j) fire
  - k) horse play
  - l) lack of instruction
2. Identify the safety regulations as they apply to safe work practices in the trade on:
  - a) general safety precautions.
  - b) house keeping, personal protective equipment and clothing
  - c) guards
  - d) grinding
  - e) rigging
3. Describe and apply safety regulations on:
  - a) use of safeguards
  - b) ladders
  - c) protection from fallings materials
  - d) fall protection systems
  - e) scaffolds, bracket, rolling, and power lifts
  - f) floor and roof openings, perimeter guardrails
  - g) temporary floors, temporary supporting structures

**D. Lab Practices ..... 24 Hours****Outcome      Demonstrate the ability to do the following.**

1. Demonstrate the ability to cope and punch holes using the ironworker machine.
2. Demonstrate the ability to start and finish a project from an approved drawing by:
  - a) laying out a fabrication project
  - b) cutting steel with oxy-fuel cutting equipment and ironworker to suit layout
  - c) tack welding components together without distortion
  - d) grinding welds on frame and clean up project

**E. Emergency First and CPR ..... 6 Hours****Outcome      Demonstrate the ability to administer immediate on-the-spot first aid to persons with minor injuries and administer temporary emergency first aid to the more seriously injured, as deemed adequate until qualified medical personnel is available.**

1. Explain the responsibilities and duties of the first aid person.
2. Explain the diagnoses for:
  - a) respiratory failure
  - b) burns
  - c) body injury

3. Apply artificial respiration.
4. Explain the process of freeing the victim of breathing restrictions.
5. Explain the process of applying mouth-to-mouth respiration.
6. Apply emergency treatment.
7. Describe the procedure for:
  - a) assessing injury
  - b) moving the patient
  - c) arresting bleeding
9. Explain the methods of:
  - a) quenching fire on a victim
  - b) treating various burns
10. Demonstrate basic one-rescuer CPR.
11. Explain what cardiovascular disease is and how it kills.
12. Explain the signs and symptoms of cardiovascular emergencies (severe angina, heart attack, cardiac arrest, etc.) and choking by their signs and symptoms.
13. Demonstrate an effective response to cardiovascular and choking emergencies.

**SECTION TWO: ..... OXY-FUEL EQUIPMENT AND TACK WELDING ..... 30 HOURS**

**A. Oxy-Fuel Equipment and Cutting ..... 7 Hours**

**Outcome:** *Demonstrate the knowledge of cutting equipment.*

1. Describe oxy-fuel equipment.
2. Describe the construction of the oxygen and acetylene cylinders.
3. Explain the procedure for handling, transporting and storing cylinders.
4. State the procedure for handling faulty cylinders.
5. Explain the construction and purpose of a manifold.
6. Describe the purpose of regulator.
7. Describe the basic construction and pressures involved for a single stage and double stage regulator.
8. Explain the construction of hoses.
9. Identify hoses and fittings.
10. Explain the C.S.A. specifications of hoses.
11. State the procedure for the repair and maintenance of hoses.
12. Describe the design and construction of cutting tips.
13. Describe and demonstrate the care, maintenance and selection of tips.
14. Demonstrate and explain the assembly of oxy fuel equipment.
15. Explain and demonstrate the correct placement and securing of cylinders.
16. Explain and demonstrate the clearing and checking of cylinder valves.
17. Attach regulators safely and correctly.
18. Attach hoses and explain reason for cleaning new hoses.
19. Attach the barrel and tip correctly.

20. Explain the correct procedure used when checking for leaks.
21. Check to assure that the regulators were not used for any other purpose than for what they were intended.
22. Demonstrate the correct pressures and flame adjustments.
23. Explain and demonstrate the correct regulator adjustments and balancing pressures.
24. List the reasons for backfires and flashbacks.
25. Define flame propagation.
26. Ignite the torch using the recommended striker.
27. Explain and demonstrate the different types of flames and uses.
28. List and demonstrate the acceptable shutting down procedure.
29. Demonstrate the fire prevention and controls for oxy fuel equipment.
30. Identify the types of fire extinguishers available and where used.
31. Define hazardous areas in construction.
32. Describe how to prevent fires.

**B. Electric Arc Welding ..... 7 Hours**

**Outcome:** *Identify SMAW Equipment.*

1. Explain basic electricity.
2. Define arc voltage.
3. Define alternating current and direct current.
4. Define resistance.
5. Explain duty cycle.
6. Define reverse and straight polarity.
7. Explain the heat distribution using reverse or straight polarity.
8. Explain voltage loss.
9. Demonstrate knowledge of arc welding machines.
10. Describe the basic components and operation of various types of welding machines.
11. Describe the basic components and operation of an A.C. - D.C. rectifier.
12. List the advantages and disadvantages of the various types of welding machines.
13. Explain the selecting, installing and maintenance of welding machines.
14. Explain the reasons for selecting a welding machine for a specific task.
15. Explain the consideration to be taken when installing a welding machine in a shop environment.
16. Explain the day-to-day maintenance required for welding machines.
17. Describe the accessories for welding machines.
18. Describe cable construction.
19. Explain cable sizing.
20. Describe the various types of electrode holders and explain the maintenance required.
21. Describe cable lugs, quick connectors and ground clamps.
22. Describe the controls on arc welding equipment.

23. Describe the controls on a welding machine.
24. Explain the arc characteristics in relation to the different voltage and amperage settings.
25. Identify mild steel welding electrodes.
26. Explain the numerical definitions of electrodes.
27. Explain the manufacturing specification control.
28. List the functions of the coating.
29. List the functions of the slag.
30. Explain the effects of alloy additions to the coating.
31. Explain static and dynamic loading.
32. Identify the types of welds:
  - a) fillet
  - b) groove
  - c) plug or slot
33. Identify the types of joints:
  - a) butt
  - b) lap
  - c) edge
  - d) tee
  - e) corner
34. Identify basic weld and welding symbols:
  - a) weld symbols
  - b) parts of the welding symbol
  - c) define arrow side and other side
35. Identify the types of basic weld faults.
36. Describe and define dimensional defects like warp age and wrong measurements.
37. Describe and define notch effect.
38. Describe and define surface and internal defects like slag inclusions, porosity and lack of fusion.
39. Describe and define GMAW, FCAW, GTAW, SAW, PAW, CAC-A and stud welding equipment.
40. Describe welding safety.
41. Describe and wear proper welding apparel.
42. Describe and wear proper welding goggles.
43. Describe the process for fireproofing materials.
44. State the use of protective screens.
45. Describe a welding helmet and illustrate the proper placement of lenses.
46. Describe and illustrate safe housekeeping practices.
47. List the rays involved with welding and the effects associated with these rays.
48. Describe the procedures to protect oneself and the general public from harmful rays.
49. List the reasons for grounding of electrical equipment.

**C. Basic Welding Lab Practices ..... 16 Hours**

**Outcome:** *Demonstrate the ability to safely operate a hand held oxy fuel cutting torch and SMAW equipment.*

1. Demonstrate the ability to safely operate a hand held oxy fuel cutting torch on available plate and structural shapes.
2. Perform safe set-up procedures.
3. Perform correct regulator adjustments and balancing pressures.
4. Perform straight line and bevel cutting on plate steel.
5. Perform cuts on various structural steel shapes.
6. Perform cutting of bolt holes in structural shapes.
7. Perform coping and fitting of various structural shapes into each other.
8. Demonstrate the ability to tack weld.
9. Demonstrate the ability to weld surface welds (stringer beads) in the flat position on available mild steel using E7018 (E4918) filler material.
10. Demonstrate the ability to weld fillet welds in the 2F position using E7018 (E4918) filler material on available steel.

**SECTION THREE: ..... DRAWING INTERPRETATION AND MATHEMATICS ..... 40 HOURS**

**A. Introduction to Drawings ..... 16 Hours**

**Outcome:** *Identify types of drawings.*

1. Identify the types of drawings:
  - a) perspective drawings
  - b) isometric drawings
  - c) oblique drawings
  - d) orthographic drawings
2. Demonstrate the ability to sketch objects in the orthographic projection.
3. Identify the parts of a drawing:
  - a) lines
  - b) dimensions
  - c) elevation and plan views
  - d) sections
  - e) notes
4. Explain the relationship of drawings.
5. Explain the requirements for architectural drawings.
6. Reasons for structural, mechanical, electrical, pre-engineered, fabrication and erection and placing drawings.
7. Identify and demonstrate the use of drawing standards:
  - a) title block
  - b) drawing number
  - c) contract numbers
  - d) scale
  - e) revisions
  - f) engineer's stamp



8. Identify symbols and abbreviations:
  - a) abbreviations used on drawings
  - b) symbols used on drawings
  - c) structural steel shapes
  - d) structural steel connections
  - e) basic welding symbols
9. Demonstrate the ability to free hand sketch:
  - a) structural shapes
  - b) a beam showing dimensions
10. Demonstrate the ability to interpret basic drawings.

**B. Trade Mathematics..... 24 Hours**

**Outcome:** *Solve problems involving fractions, decimals, percentage, metric and imperial measurements, and geometric formulas.*

1. Identify key terms and concepts used in working with fractions.
2. Change fractions to a common denominator.
3. Solve problems using whole numbers and fractions.
4. Solve problems using whole numbers and fractions in practical applications.
5. Read and write decimal fractions.
6. Round decimal fractions to specified place values.
7. Convert decimal inches to a fraction with a practical denominator.
8. Convert decimal feet to feet and inches with a practical denominator.
9. Convert fractions to decimals.
10. Add and subtract decimal fractions.
11. Multiply and divide decimal fractions.
12. Convert between fractions and percents.
13. Convert between decimals and percents.
14. Calculate ratio problems: two quantities in the form of a ratio and two ratios in the form of a proportion.
15. Solve percent problems.
16. Identify commonly used metric units of measurement.
17. Convert between units of measurement.
18. Convert imperial units: feet to inches, square inches to square feet, and cubic measures to gallons.
19. Identify key terms and concepts used in working with formulas.
20. Identify common formulas for perimeter, area and volume.
21. Solve problems using common formulas for perimeter, area and volume.
22. Calculate the capacity of a container in gallons.
23. Calculate the weight of a solid.

## SECTION FOUR: ..... LEVEL ONE RIGGING ..... 58 HOURS

## A. Ropes and Fittings ..... 12 Hours

**Outcome:**      *Apply safe work practices and procedures when rigging.*

1. Identify and define wire ropes.
2. List the types of steel for wire rope.
3. List and explain:
  - a) basic types of lays
  - b) advantages of lays
  - c) available type of core
  - d) where cores are used
4. Describe the four basic classifications of wire rope.
5. Explain W.L.L. (working load limits) and when a wire rope is unsafe.
6. Identify and define fibre ropes.
7. Define lays of fibre rope.
8. Describe why a certain fibre would be used.
9. List factors and formulas for natural and synthetic fibre ropes.
10. Describe types of synthetic ropes why and when used.
11. Identify and list the use of various knots and hitches.
12. Identify and define synthetic slings.
13. Explain formulas for different types of synthetic slings.
14. Explain proper methods of care and handling of slings.
15. List and describe wire rope fittings.
16. List and describe uses of the following fittings:
  - a) clips
  - b) sockets
  - c) thimbles
  - d) rings
  - e) shackles
  - f) hooks
17. Describe how proof loading works.
18. List and describe formula and their uses for:
  - a) slings
  - b) guys
  - c) chains
  - d) clips
19. Identify and describe rigging aids.
20. Identify and describe the uses for:
  - a) spreader bar
  - b) balance beam
  - c) equalizing beam

**B. Hoisting Devices ..... 6 Hours****Outcome:** *Identify and describe hoisting devices.*

1. List and describe manual and power assisted hoisting devices.
2. List and describe cranes:
  - a) types of mobile cranes
  - b) parts of a mobile crane
  - c) parts of a crawler crane
  - d) safe operating and working practices

**C. Introduction to Load Charts ..... 2 Hours****Outcome:** *The ability to identify parts of load charts.*

1. List and describe the following parts of a load chart:
  - a) type of crane base
  - b) type of crane configuration
  - c) areas of operation
  - d) length of boom
  - e) angle of boom
  - f) load radius

**D. Signals ..... 2 Hours****Outcome:** *Identify and demonstrate the use of signals.*

1. List and demonstrate signals used for:
  - a) moving equipment
  - b) hoisting
2. Describe methods and precautions in using hand signals.
3. Describe and demonstrate the use of voice communications:
  - a) radio (2 way and walkie talkie)
  - b) intercom (station to station)
4. Describe precautions used in voice communication.

**E. Level One Rigging Lab Practices..... 18 Hours****Outcome:** *Demonstrate the safe use of hoisting equipment.*

1. Demonstrate slings and hitches used for preparing and lifting materials.
2. Demonstrate the ability to tie knots and hitches and awareness of load limits:
  - a) bowline
  - b) clove hitch
  - c) sheet bend
  - d) scaffold hitch and self-centering bowline
  - e) bowline on a bight
3. Demonstrate the proper use of slings and tag lines.

4. Demonstrate proper use and location of slings for lifting:
  - a) smooth heavy loads
  - b) long flexible loads
  - c) off balance loads
  - d) fragile loads
5. Identify Working Load Limits (W.L.L.).
6. Test knots and splices.

**F. Scaffolding..... 3 Hours**

**Outcome:** *Apply safe work practices when using Scaffolding.*

1. Identify scaffold systems and structures:
  - a) scaffold components and materials
  - b) scaffold safety and access
  - c) tying and bracing scaffolds
  - d) base conditions for scaffolds
  - e) erection and dismantling procedures
  - f) needle beam platform
2. List and describe safety rules for access structures.

**G. Swing Stage and Aerial Work Plat Forms ..... 3 Hours**

**Outcome:** *Apply safe work practices when using swing stage and aerial work plat forms.*

1. Describe and explain:
  - a) conventional swing stage
  - b) platform components
  - c) thrust outs and support hooks
  - d) wall rollers and tie offs
  - e) manual winches
  - f) power swing stage hoists
  - g) fall arrest equipment
  - h) wire rope and fittings
  - i) swing stage safety rules and regulations
  - j) accident awareness
  - k) check list, precautions, inspections, and maintenance
2. Describe the safe use of aerial work platforms and forklifts.
3. Describe common types of material and personnel lifts and their components.
4. Describe acceptable safety precautions to be used when operating material and personal lifts.
5. Describe manufactures specifications and recommendations for aerial work platforms and forklifts.

**H. Fall Protection ..... 2 Hours**

**Outcome:** *Identify and describe the safe use of fall protection systems.*

1. Identify and describe the safe use of fall protection systems.
2. Identify situations where fall protection systems are required.
3. Identify the procedure for correctly fitting a harness.
4. Identify the components for vertical and horizontal lifelines.
5. Describe the procedures for equipment inspections.

I. Scaffolding, Swing Stage and Fall Protection Lab Practical ..... 10 Hours

**Outcome:**        *Demonstrate the ability to safely use Scaffolding, Swing-stage, Aerial Work Platforms and Fall Protection Systems.*

1.     Demonstrate the ability to erect the following scaffold systems:
  - a)    frame (metal)
  - b)    modular
  - c)    tube and clamp
2.     Demonstrate the ability to use swing stage and aerial work platforms.
3.     Demonstrate the ability to use fall protection systems.

**SECOND PERIOD TECHNICAL TRAINING  
IRONWORKER TRADE  
COURSE OUTLINE**

**UPON SUCCESSFUL COMPLETION OF THIS COURSE THE APPRENTICE SHOULD BE ABLE TO PERFORM THE  
FOLLOWING OUTCOMES AND OBJECTIVES.**

**SECTION ONE: ..... DRAWING INTERPRETATION AND MATHEMATICS ..... 60 HOURS**

**A. Reinforcing Steel Drawings ..... 24 Hours**

**Outcome:        *Demonstrate the ability to read and interpret reinforcing steel drawings.***

1. Identify the following types of reinforcing steel drawings:
  - a) architectural drawings
  - b) structural drawings
  - c) reinforcing steel placing drawings
  - d) reinforcing steel abbreviations and symbols
2. Sketch an orthographic projection drawing.
3. Identify the following types of concrete construction from structural engineering and reinforcing steel placing drawings:
  - a) foundations and footings
  - b) walls
  - c) columns
  - d) slabs
  - e) beams, joists, and girders
4. Identify and compile the following types of reinforcing steel drawings:
  - a) the reinforcing steel from a structural engineering drawing
  - b) the reinforcing steel from a reinforcing steel placing drawing
  - c) a cutting or bar list from a reinforcing steel placing drawing
5. Identify and prepare schedules from a structural engineering drawing:
  - a) footings
  - b) columns
  - c) beams and joists
  - d) slabs
6. Interpret and analyze the following reinforcing steel drawings:
  - a) foundations and footings
  - b) wall and columns
  - c) one way slabs and two way slabs
  - d) beams and slab
  - e) beam joists and waffle slabs
  - f) waffle slabs
  - g) bridge decks, piers and abutments
  - h) tanks and silos
  - i) pre-cast members
  - j) reinforcing steel placing
7. Interpret the placing sequences for two way flat slab and for a beam and a slab.
8. Interpret:
  - a) various types of reinforcing steel drawings
  - b) different types of construction
9. Interpret of reinforcing steel placing drawings.

**B. Post-Tensioning Drawings..... 12 Hours**

**Outcome:** *Demonstrate the ability to read and interpret post-tensioning drawings.*

1. Identify the two types of post-tensioning as shown on drawings:
  - a) bonded
  - b) unbonded
2. Identify the post-tensioning system being used as shown on drawings:
  - a) wire
  - b) bar
  - c) strand
3. Identify the post-tensioning anchorage needs as shown on drawings:
  - a) pocket clearance
  - b) anchor recess
  - c) anchor zone reinforcing
  - d) type of anchorages
  - e) types of stressing equipment
4. Identify the post-tensioning symbols and abbreviations used on drawings:
  - a) stressing ends anchorages
  - b) dead end anchorages
  - c) support systems
  - d) tendon symbols
  - e) drape profile
  - f) anchor zone reinforcing
5. Identify the types of post-tensioning concrete construction from structural engineering and post-tensioning drawings:
  - a) slabs
  - b) beams
  - c) slabs and beams
  - d) beams and joists
  - e) bridge girders
  - f) silos, tanks, and slab on grade
6. Identify and compile:
  - a) the post-tensioning requirements from a structural engineering drawing
  - b) tendon cutting list from a post-tension placing drawing
  - c) a stressing data sheet from the tendons from a post-tensioning drawing
  - d) calculate elongations and stressing lengths from post-tensioning drawings
7. Prepare material take offs for:
  - a) the post-tensioning support system
  - b) anchorages and anchor zone reinforcing
8. Interpret post-tensioning drawings.
9. Compile material take-offs from post-tensioning placing drawings.

**C. Mathematics and Estimating ..... 24 HOURS**

The mathematics delivered under this section shall maintain a level applicable to the tradesman, and have a definite relationship to functions experienced in the trade of an Ironworker.

**Outcome:**        *Demonstrate the ability to solve mathematical problems.*

1. Demonstrate ability to solve imperial and metric linear measurement problems using:
  - a) fractions
  - b) decimals
  - c) conversions between decimal and fractions
2. Calculate ratios and proportions.
3. Calculate similar triangles.
4. Calculate slopes.
5. Calculate percentages:
  - a) calculate simple interest
  - b) calculate discounts
6. Calculate the perimeter and area of:
  - a) squares and rectangles
  - b) triangles
  - c) circular objects
  - d) parallelograms
  - e) irregular shapes
7. Solve area measurement problems using:
  - a) unit of area measure
  - b) conversions of area units
  - c) plane figures (rectangle, circle, etc.)
8. Solve volume measurement problems using:
  - a) units of volume measurement
  - b) conversions of volume units
  - c) volume figures (cube, cone, etc.)
9. Calculate quantities related to study of plans and drawings:
  - a) general - scaffolding, equipment use, etc.
  - b) cutting list for specified projects
  - c) fasteners required
10. Define triangulation using the appropriate formulas, calculate a position by means of bearings from two fixed points a known distance part.



## SECTION TWO: ..... REINFORCED CONCRETE ..... 102 HOURS

## A. Concrete ..... 6 Hours

**Outcome:** *Describe the basics of concrete and its usage.*

1. Describe the various types of cement.
2. Explain the history of cement.
3. Describe concrete and list its uses.
4. Describe grouts and explain applications.
5. List the basic principles of stresses in concrete:
  - a) compression
  - b) tension
  - c) shear
  - d) live and dead loads
  - e) physical and mechanical bonds
6. List the basic principles of deflection as reinforcing steel is used to counteract the stresses in concrete.
7. Describe conditions where reinforcing in concrete is needed.

## B. Reinforcing Steel ..... 32 Hours

**Outcome:** *Describe the basics of reinforcing steel and its safe usage.*

1. Explain how reinforcing steel is manufactured.
2. Describe the reinforcing steel and mill standards.
3. Identify the various grade strengths and diameters of reinforcing steel.
4. Identify reinforcing steel according to colour coding.
5. Describe appropriate fabrication methods including:
  - a) cutting
  - b) bending
  - c) calculating and measuring
  - d) cutting and bending schedules
6. Explain and demonstrate safe use of bending and cutting equipment.
7. Explain the placing and placing codes of reinforcing steel.
8. Describe the basic reinforcing steel ties required for placing reinforcing steel.
9. Explain the uses of the reinforcing steel ties in placing reinforcing steel.
10. Identify all reinforcing steel splicing.
11. Calculate the splicing lengths of reinforcing steel.
12. Identify the placing tools required to place reinforcing steel.
13. Identify and describe the uses of reinforcing steel supports used in placing.
14. Identify and describe safety in fabrication and placing of reinforcing steel.
15. List and demonstrate the safety precautions of unloading reinforcing steel.
16. Describe the safety precautions used in tying reinforcing steel.

17. Identify all aspects of unsafe use of reinforcing steel placing tools.
18. Demonstrate an ability to calculate the weights of reinforcing steel.
19. Review introduction to reinforcing steel and concrete.

**C. Reinforcing Steel Lab Practices .....36 Hours**

**Outcome:** *Demonstrate the ability to sort, cut, place and tie reinforcing steel.*

1. Sort reinforcing steel according to size.
2. Cut reinforcing steel according to a cutting list using the shearing machine in a safe, efficient manner.
3. Apply colour code to the reinforcing steel to identify cutting lengths.
4. Demonstrate safe operation of the bending machine.
5. Bend reinforcing steel into 90° and 180° hook bars as per bending sheet using the bending machine and correct pin diameter.
6. Tie the cut and bent reinforcing steel into bundles.
7. Demonstrate the ability to place reinforcing steel.
8. Tie wire ties in the horizontal and vertical positions.
9. Tie a double curtain wall according to specifications on a drawing.
10. Tie columns as per column schedule.
11. Tie a reinforcing steel mat as per information sheet.
12. Perform the following:
  - a) shear reinforcing steel from cutting list
  - b) bend reinforcing steel from bending schedule
  - c) colour code all sheared and bent reinforcing steel
13. Place a two-way flat slab from a drawing using the correct:
  - a) placing sequence
  - b) support systems
  - c) ties for securing reinforcing steel
14. Demonstrate safe working practices while operating equipment:
  - a) inspection of reinforcing steel for a flat slab from the drawing
  - b) check that all reinforcing steel
    - i) is in the correct position
    - ii) is correctly tied
    - iii) is lapped correctly
    - iv) has the correct sequence
15. Dismantle reinforcing steel:
  - a) untie all the wires from the reinforcing steel
  - b) remove all the chairing and replace in correct location
  - c) sort all reinforcing steel in correct location
  - d) clean up the deck and the equipment
  - e) dispose of all loose wire

**D. Cranes..... 12 Hours****Outcome:** *Describe safe procedures for lifting, hoisting or moving loads.*

1. Demonstrate or describe:
  - a) general use of tables and charts
  - b) signals
  - c) boom assembly and disassembly
  - d) components
  - e) breakdown for transportation
  - f) safety precautions
  - g) deductions from gross capacity to determine net capacity
2. Describe the reason for and load reduction when jib is fitted on the boom.
3. List and describe safe working practices for tower cranes.
4. Identify and describe the following cranes:
  - a) hydraulic
  - b) conventional
  - c) rough terrain
  - d) high capacity

**E. Post-Tensioning..... 10 Hours****Outcome:** *Describe post-tensioning its usage and safety issues.*

1. Define post-tensioning.
2. List and explain the safety aspects of stressing.
3. Identify the two types of post-tensioning:
  - a) bonded
  - b) unbonded
4. Identify the post-tensioning systems:
  - a) bar
  - b) strand
5. Identify the post-tensioning anchorages:
  - a) type of anchorages
  - b) single strand anchor
  - c) multi-strand anchor
  - d) bell anchor
  - e) shim anchor
  - f) lock nut anchor
  - g) anchor zone reinforcing
  - h) anchor recess and pocket clearances
6. Define prestressing.
7. List and explain the applications of prestressing.
8. State the safe stressing procedures.
10. Explain the procedures in tendon placement.
11. Identify and describe the use of the tendon support system.
12. Explain the procedures in placing anchor zone reinforcing.

## F. Post-Tensioning Lab Practices ..... 6 Hours

**Outcome:** *Demonstrate the ability to operate stressing equipment, a grouting pump and fabricate a beam.*

1. Demonstrate the operation of stressing equipment.
2. Identify the parts of the stressing pump.
3. Operate the stressing pump.
4. List safety precautions of the pumping operation.
5. Identify the parts of various stressing jacks.
6. Operate two types of stressing jacks together.
7. Identify a safe method to check stressing gauges.
8. Demonstrate setting the by-pass safety valve on stressing jack.
9. Demonstrate the operation of post tension grouting pump.
10. Identify the parts of the grouting pump.
11. Operate the grouting pump.
12. List safety precautions while operating grout pump.
13. Demonstrate mixing of grout.
14. Demonstrate cleaning of the grout pump after grouting operation.
15. Demonstrate the ability to fabricate a beam:
  - a) drape
  - b) supports
  - c) anchors
16. Describe tension instillation:
  - a) bar strand
  - b) multi strand
17. Tie the cut and bent reinforcing steel into bundles.
18. Tie wire ties in the horizontal and vertical positions.
19. Tie a double curtain wall according to specifications on a drawing.
20. Tie columns as per column schedule.
21. Tie a reinforcing steel mat as per information sheet.
22. Tie a reinforcing steel beam as per placing drawing.

## SECTION THREE: ..... TRADE RELATED KNOWLEDGE .....18 HOURS

## A. Business Knowledge ..... 10 Hours

**Outcome:** *List and describe basic business knowledge.*

1. Demonstrate the correct procedure for developing reports and filling in time cards.
2. Interpret written orders.
3. Interpret requests and conditions.
4. Explain the responsibilities that an ironworker has to:
  - a) oneself, fellow workers and general public
  - b) the foreman and employer
  - c) Apprenticeship and Trade Certification
  - d) provincial labour standards
  - e) company policies and procedures
5. Describe the following workplace coaching skills, used for training apprentices:
  - a) identify the point of the lesson
  - b) link the lesson
  - c) demonstrate a skill
  - d) provide opportunity to practice a skill
  - e) give feedback to the learner
  - f) assess the learner's progress
6. Explain the public relations an Ironworker has in:
  - a) co-operation with allied trades
  - b) co-ordination with other trade functions
  - c) recognition of work related problems
  - d) consideration of public needs
7. Listen to guest speakers of the training establishment's choice who may include trade experts or product representatives:
  - a) W.C.B.
  - b) O.H. & S.
  - c) company representatives (Q.A., production superintendent, safety coordinator, owners, job coordinator, estimator)
  - d) C.W.B. representatives
  - e) personal protection equipment supplier
8. Demonstrate the ability to perform basic computer skills.

## B. Materials Knowledge ..... 6 Hours

**Outcome:** *Describe basic materials.*

1. Define and describe the following types of physical and mechanical properties of metals:
  - a) density
  - b) brittleness
  - c) ductility
  - d) elasticity
  - e) hardness
  - f) thermal and electrical conductivity
  - g) malleability
  - h) tensile strength
  - i) toughness
  - j) coefficient of expansion
  - k) melting and boiling points

2. Explain the chemical composition of steel.
3. Describe:
  - a) effects of elements in steel
  - b) carbon, manganese and silicon
  - c) sulphur and phosphorus
4. Describe the following types of classifications of steels:
  - a) carbon and alloy steels
  - b) steel code classifying systems such as S.A.E. and A.I.S.I.
  - c) A.S.T.M. and C.S.A. designations of structural steels
5. Describe the types of coatings.

**C. Quality Control ..... 2 Hours**

**Outcome:** *Describe the basics of quality control.*

1. Describe methods of inspection.
2. Explain scope and quality control /assurance (ISO-9000).
3. Discuss elements of a quality control (Q.C.) system and why it is used.
4. Identify method of Q.C. used by the Steel Fabrication Industry today to insure quality.
5. Discuss relationship between Q.C. personnel and tradespersons.
6. Describe the difference between a standard and code.
7. Discuss functions of standards, codes, specifications and procedures.
8. Define scope of Q.C. inspection.
9. Describe and observe each method of non-destructive and destructive testing.
10. Describe methods of inspecting welds.





*Excellence through training and experience*

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